

Remarks

Reconsideration of the subject application is requested in view of the foregoing amendments and the following remarks.

The search performed by the Examiner in performing a substantive examination of the claims is appreciated.

The amendments to the specification are to provide updated information regarding the citations. No new matter is submitted.

Claims 1-20 are pending. In this Amendment, claims 1, 4, 10, 16, and 20 are amended; claim 3 is canceled without prejudice; claims 2, 5-9, 11-15, and 17-19 are unchanged; and new claims 21-24 are submitted for consideration.

Claims 1, 16, and 20 are amended so as to make each of these claims independent. Specifically, claim 1 as amended represents a combination of the features specifically recited in claims 1 and 3 as filed (resulting in cancellation of claim 3), claim 16 as amended represents a combination of the features specifically recited in claims 13, 14, and 16 as filed, and claim 20 as amended represents a combination of the features specifically recited in claims 18 and 20 as filed. The Office action stated that claims 3, 16, and 20 would be allowed if rewritten in independent form. In view of these amendments to claims 1, 16, and 20, allowance of these claims is hereby requested.

Claim 10 is amended to make the claim independent, namely by combining claim 1 as filed with claim 10 as filed. New claims 21-24 depend from claim 10 as amended, and correspond (except for dependency) with claims 3, 4, 7, and 8, respectively, as filed. Hence, no new matter is submitted by these new claims.

Claim 4 is amended to more clearly recite that beam-transmitting measurement marks are defined at multiple locations in the subfield. See, *e.g.*, FIG. 6.

The issue raised at the top of page 2 of the Office action is cured by the inclusion herewith of an IDS citing two references mentioned in the Background section of the instant application. In this regard, notice is hereby taken that JP 2001-203149 is the published (*Kôkai*) version of JP 2000-12620, as readily seen on the cover page (see item (21)) of this reference. Notice also is hereby taken that Japan *Kôkai* Patent Document *Hei* 10-289851 corresponds to Japan patent application no. *Hei* 9-95776, to which US Patent No. 6,059,981 is a counterpart, as

readily seen on the cover page (see item (30)) of the US Patent. Hence, the IDS cites the JP 2001-203149 reference and the US 6,059,981 reference. The IDS also cites US 5,396,077 and a *J. Vac. Sci. Technol.* paper recently discovered by Applicant.

Claims 1-2, 4-6, 9, 11, 13-15, and 17-18 stand rejected for alleged obviousness from "Applicant's admitted prior art in view of Kawata (6,403,971)." This rejection is traversed.

The rejection of claims 1-9 is moot in view of the amendment of claim 1 to include the feature recited in claim 3. In addition, claim 1 as amended is distinguished from the newly disclosed '077 patent because, *inter alia*, that reference is silent on the recited axial distance and on the recited axial angle of the beam-limiting aperture. (A depiction of the relative amount of the beam that is scattered in the '077 patent is shown in FIG. 5 of that reference.)

Claim 4 is distinguished over the '077 patent because, *inter alia*, this reference is silent on having measurement marks in multiple locations in a subfield.

Claim 7 is distinguished over the '077 patent because, *inter alia*, this reference is silent on using a dummy pattern as defined in a subfield.

Claim 11 requires, *inter alia*, the following: (a) a beam-transmitting measurement mark situated at an object plane, (b) a knife-edged reference mark defined at an image plane as a corresponding through-hole in a charged-particle-scattering membrane, (c) an illumination-lens assembly situated and configured to direct a charged-particle beam at the measurement mark so as to form a charged-particle beamlet propagating downstream of the measurement mark toward the reference mark, (d) a projection-lens assembly situated and configured to project the beamlet onto the reference mark and to scan the beamlet over a knife-edge of the reference mark to produce non-scattered charged particles that are transmitted through the through-hole and forward-scattered charged particles that are transmitted through the membrane, (e) a beam-limiting diaphragm situated downstream of the reference mark, wherein the diaphragm comprises a diaphragm plate defining a beam-limiting aperture that passes the non-scattered charged particles as the diaphragm plate blocks most of the forward-scattered charged particles, and (f) a detector situated and configured to detect a beam current of the charged particles propagating downstream of the beam-limiting aperture.

The "prior art" disclosed by Applicant is presumed to be the JP 2001-203149 and US 6,059,981 references cited in the specification. The various shortcomings of these references are discussed on page 2, line 34 to page 5, line 2 of the instant specification. Neither of these

references is understood to teach or suggest providing or using the recited beam-limiting aperture, either alone or in combination with any of features (a)-(f) listed above. Also, neither of these references is understood to provide any hint of any possible reasons for which the recited beam-limiting aperture might be desirable or necessary, either alone or in combination with any of features (a)-(f) listed above. Indeed, the Office action admits that "Applicant's disclosure of prior art does not disclose an illumination lens assembly and a projection lens assembly in addition to the disposal of a beam-limiting diaphragm situated downstream of a reference mark" wherein the "beam-limiting aperture [comprises] a diaphragm plate defining a beam-limiting aperture having a diameter sufficient to block most of the forward-scattered charged particles while not blocking the non-scattered charged particles from reaching the detector."

Kawata appears to have been cited for its alleged disclosure of a microlithographic method and apparatus that includes an illumination-lens assembly and a projection-lens assembly that includes a contrast aperture (item 23). The Office action contends, "It would have been obvious . . . to include the beam limiting diaphragm of Kawata with the prior art disclosed by the Applicant because the inclusion of the diaphragm of Kawata inhibits scattered particles from reaching the detector, which allows for easier axial adjustment as well as increasing the signal-to-noise ratio." This contention is misplaced. First, claim 11 requires that the reference mark be located at the image plane and that the beam-limiting diaphragm be located downstream of the reference mark (and thus downstream of the image plane). In Kawata, in contrast, item 23 is situated substantially upstream of the image plane (see FIGS. 1 and 3). Second, in FIGS. 1 and 3 of Kawata, the detector 35 is situated substantially at the image plane (see also col. 6, lines 42-43). There is no apparent teaching or suggestion that the detector 35 could be or should be located downstream of the image plane and/or that the beam must pass through a beam-limiting diaphragm as the beam propagates from the image plane downstream to the detector. Thus, there is no teaching or suggestion of detecting beam current of charged particles passing through such a beam-limiting aperture. Third, in Kawata, imaging performance is performed by passing the beam selectively through a white or black subfield, col. 7, lines 11-16, neither one of which being a "mark" *per se*. Thus, there is no teaching or suggestion of defining a knife-edged reference mark or of scanning a beamlet over a knife-edge of the reference mark while projecting the beamlet onto the reference mark. In view of these deficiencies of Kawata, and with respect

to claim 11 (as well as claims 13 and 18), the shortcomings of "Applicant's admitted prior art" are not satisfied by Kawata.

Regarding claim 15, the Office action contends that "Kawata discloses projecting the beamlet using first and second projection lenses." This is incorrect. Since in Kawata the beam encounters either a white or black subfield, no "beamlet" is produced or projected in the claimed manner. Even if Kawata disclosed the claimed beamlet (and no such admission is made), this would not cure the many deficiencies of Kawata with respect to claims 13 (from which claim 15 depends) and 15.

Regarding claims 4-6, the Office action contends that "Kawata discloses defining the measurement mark as a respective aperture in a subfield (41) of a reticle (15)." This contention is incorrect. The text of Kawata allegedly providing such a disclosure is directed to the projection of pattern portions from the reticle 15 to the substrate, not to the configuration of a measurement mark. Furthermore, in Kawata, adjustments are made using white and black subfields; neither of these types of subfields contain measurement marks at multiple locations in a subfield, and neither of these types of subfields define "marks" *per se*. Furthermore, Kawata is directed to performing an axial alignment (col. 7, lines 24-26), not to detecting beam blur at multiple locations within a subfield as recited, *e.g.*, in claim 4.

Regarding claims 9 and 17, the Office action contends that Applicant's admitted prior art discloses that "the through-hole in the charged-particle-scattering membrane is provided with a rectangular profile." Even if said prior art provided such a disclosure (and Applicant makes no such admission), such a disclosure would not cure the deficiencies of any combination of said prior art and Kawata.

In view of the discussion above, claims 1-2, 4-6, 9, 11, 13-15, and 17-18 are properly allowable over the cited references.

Claims 7-8, 10, 12, and 19 stand rejected for alleged obviousness from a combination of "Applicant's admitted prior art in view of Kawata in further view of and Kojima (6,441,384). This rejection is moot with respect to claims 7-8, and is traversed with respect to claims 10, 12, and 19.

The deficiencies of a combination of "Applicant's admitted prior art" and Kawata are discussed above. The Office action admits, that "the disclosed prior art and Kawata do not disclose the use of a dummy pattern." Kojima appears to have been cited for its alleged

disclosure of using a dummy pattern. In reply, it is pointed out that the text in Kojima (col. 12, lines 39-47) cited in the Office action is not directed to use of a dummy pattern or dummy beam but rather to a dummy substrate. A dummy substrate is not a dummy pattern and does not produce a dummy beam, and is used for a different purpose than a dummy pattern or dummy beam. Hence, there has been no showing that Kojima provides the teaching alleged in the Office action, and certainly no showing that Kojima fulfills in any way the various deficiencies of any combination of said prior art and Kawata.

Claim 8 (see also new claims 23-24) requires the production of at least one dummy beam propagating downstream of the measurement mark, wherein the detection step comprises detecting beam blur of the beamlet attributable to a space-charge effect resulting from the dummy beam. Neither Kawata nor Kojima disclose or suggest such a detection step. In the cited section of Kojima, the dummy substrate (not dummy beam) is used for performing a focus adjustment wherein the dummy wafer is exposed at several axial positions and the exposure results are determined by scanning electron microscopy. This procedure and result discussed in Kojima is not, and does not lead to, the instantly claimed detection of beam blur of the beamlet resulting from a dummy beam.

Regarding claims 10, 12, and 19, the Office action admits that "neither the disclosed prior art nor Kawata disclose the disposal of a second beam-limiting diaphragm downstream of the first beam limiting diaphragm, having the same features and functions of the first beam limiting diaphragm." Kojima is cited for its alleged disclosure of first beam-limiting diaphragm (allegedly item 15) and a second beam-limiting diaphragm (allegedly item 2b). These allegations are incorrect. In Kojima item 15 is an aperture plate used for forming a hollow illumination beam (col. 11, lines 38-52). The aperture plate 15 does not block a scattered beam, and scattering does not occur upstream of the aperture plate 15. Rather, the beam is scattered only at the reticle 7 (FIG. 9 of Kojima). Hence, Kojima does not provide the teaching alleged in the Office action and does not fulfill the several deficiencies of said prior art and Kawata.

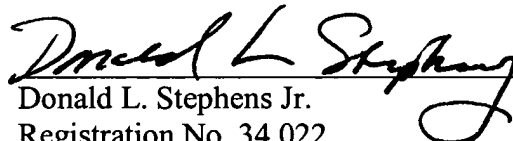
In the newly cited '077 patent, only one beam-limiting aperture is disclosed (e.g., item 7, wherein item 2 in FIG. 5 corresponds to a reference mark). The reference provides no hint of the desirability, need, or benefits of providing a second beam-limiting diaphragm.

Therefore, all the now pending claims (as well as new claims 21-24) are allowable, and early action to such end is requested.

Respectfully submitted,

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